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ABSTRACT

Some factors in the design of instructional micrcomputer simulations that high school social studies teachers must consider when selecting and using computer software are discussed: (1) Instructional computer simulations are adequate instructionally only to the extent that they make explicit the set of relationships underlying the program for the simulation. (2) Students must have access to the system model so that they can understand why a particular action leads to a particular consequence. (3) The simulation must accurately model the observed phenomena in the real world. (4) Instructional simulations of abstract relationships must at a minimum provide both iconic and symbolic representations of the relationships. (5) Instructional simulations of social relationships and systems must not only provide iconic and symbolic representations of the systems; they must also provide, in a context external to the computer, for enactive experience to authenticate the parallel enactive-social experience in the real world phenomena. (6) Teachers must be able to differentiate between social and non-social content, and when teaching non-social content, must be sure to debrief students on the connections between the two. (RM)

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SOME ISSUES IN THE DESIGN, SELECTION AND UTILIZATION OF INSTRUCTIONAL SIMULATIONS IN A MICROCOMPUTER MODALITY

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In the past few years there has been considerable enthusiasm for integrating micro-computers into the instructional process in elementary and secondary schools. A natural affinity between the systematic procedures of the computer and the logico-mathematical orientations of science has lead to a public expectation that the computer would find its natural home in the science and mathematics curriculum of the secondary school. The evidence for its effectiveness is widely publicized and certified by acknowledged experts (see Skinner, 1984). Similarly, the potential of the computer for presenting learning programs of a drill/practice nature, and providing immediate knowledge of results, has prompted many educators to look on the computer as a natural aid to the elementary teacher.

Very little attention, however, has been directed to the question of the optimal role for the computer in the secondary social studies classroom. It is to this issue that this paper is addressed.

Social studies teachers are responsible for teaching many types of content. They are charged with teaching much information that is factual in nature (geographic place locations, historical dates, names of people, battles, wars, laws and organizations). They are also responsible for teaching much that is conceptual or relational in nature (economic depression, balance of trade, money, market, impeachment, monopoly, gerrymander, etc.). And they are charged with teaching knowledge of systems (capitalism, communism, democracy, socialism) or transformations in systems (revolutions, evolution, inflation, urbanization, etc.).

The content of a factual nature, which for the most part can be taught on a drill/practice basis, has already been seized upon by software developers as an appropriate curricular area for their attentions. Consequently there are software packages available for drilling students on the names and locations of states,

and cities, important events and people, and other forms of unitary information.

The argument for using the computer to conduct drill/practice activities rests upon several key features of computers; (1) the computer can deal with individual students on a one to one basis for an indefinite length of time and can modify the rate of progress according to the success of the student; (2) the computer will provide immediate knowledge of results; (3) the computer never gets bored. Taken together these realities make a convincing case for using computers in elementary social studies.

An even more compelling case, however, can be made for using computers in the secondary social studies curriculum for teaching very abstract knowledge of concepts, relationships and systems. The argument here rests upon four propositions: (1)most adolescents are not fully formal operational, but a primary function of the secondary school is to facilitate that development; (2)learners who have not fully developed formal operational thought capabilities require immediate, direct real world data if they are to perform formal operations; (3) simulations provide immediate, direct data in a simplified form but more or less an approximation of the real world; (4) computer simulations of abstract social relations and systems have high potential as learning tools because of the computer's capabilities for facilitating the handling of complex data in social simulations. In this context the computer may be able to do things that the live classroom teacher cannot, primarily because the more sophisticated simulations of political and economic systems require extensive data manipulation which, if performed by hand, will quickly exhaust the student motivation for continuing the simulation.

Social simulations have long been advocated as a means of making abstract concepts, relationships and systems comprehensible and meaningful to students who are not fully formal operational. Evidence of the effectiveness of simulations in the teaching of abstract material to average late adolescent students

has been provided (see Fraas, John, 1977). Serious limitations of computers in social simulations are evident, however. The nature of these limitations become clear when the nature of simulation in relation to real world experience is examined. An analysis of these limitations in relation to the nature of knowledge follows.

The simulation experience of a system is often a close approximation of the real world experience of a system. Students going through a simulation experience the operation of the system, and this relational-contextual information is recorded in near-narrative form, where the student can use the experience (or the traces of it in working memory) as a reference point for reflection on the relationships operating in the system. Of presumed importance here is the visibility of the cause-effect chains operating within a system, a visibility which makes concrete in participant behavior the abstractions which constitute the system. The learning potential of social simulation is perhaps analogous to an old used car as a teaching tool for training auto mechanics. By letting the students play around with the engine the teacher facilitates the student internalization of a visual model of the internal combustion engine system and all the associated sub-systems. In like fashion the students who 'play' a social simulation can build an internal representation of the social system. In either case the internal representation of the system provides the reference point for thought about the system.

This superficial analysis of the way in which a simulation facilitates learning provides some insight into the optimal form of future computer simualtions of social systems for instructional purposes.

Computer Simulations for Instruction vs. Computer Simulations for Research

When the computer is used to simulate a complex system of relationships the computer program can accomodate these relationships through processes that are never made visible to the person at the terminal. Thus if x varies as a function of y, then x will change value regardless of whether the computer has been instructed to print the change in x. The operations of the computer can be effectively hidden

from view.

When computer simulations are designed to allow researchers to predict the ramifications of a change in one or more variables in an interactive complex the researchers do not necessarily have to be able to observe the system. Since they more than likely created the simulation of the system, they can understand what is occurring by observing changes in particular variables after the fact.

Computer simulations for instruction as opposed to those designed for research must meet different requirements, however. When computer simulations are designed as instructional tools, it becomes critically important that the system which organized the relationships between variables be made explicitly visible to the learner. It is only through access to the system model in a display format that the learner can understand why a particular action leads to a particular consequence several steps removed down a chain of causation.

If a simulation of a third world country's economic-political system allows only for particular choices on the part of the learner, and then provides immediate feedback only on the consequences of those choices, the meaning of the simulation as an instructional tool becomes obscured and the experience becomes a guessing game. The novice, in order to transform a guessing game into a meaningful reflective learning experience, must have some working model of the relationships operative in the system. An essential feature of an instructional simulation, then, is access to a model of the set of relationships which are being simulated.

The Authenticity Problem

The authenticity of a simulation is defined as the degree to which a simulation accurately models the observed phenomena in the real world. Simulations of concrete phenomena must necessarily be the equivalent of Xerox copies of the real thing, because the real thing has a substantive reality in the external world. Simulations of abstract phenomena (concepts, relationships, systems, transformations) necessarily simplify the real world in the same manner that concepts, relationships, systems

and transformations focus on the general characteristics of phenomena and eliminate the idiosyncratic characteristics associated with particular examples of the phenomena in the real world. The simulation thereby simplifies the real world but closely models the mental representation of the abstraction. As an illustration direct your attention to the abstract concept 'economic depression'. The real world phenomena of an economic depression may be observed historically in the Great Depression of the 1930's, the Panic of 1873, the Depression of 1884, and the Panic of 1893. The concept of an economic depression, however, is an abstraction from these real world occurrences. That abstraction is constructed from the set of characteristics associated with all economic depressions, i.e., the decline of GNP over time. The concept of economic depression does not contain such qualities as mass unemployment, breadlines, bank failures, and stock market crashes, although some depressions might have been accompanied by these. These are noisy attributes (Hunt and Metcalf, 19) associated with the Great Depression of the 1930's and on an irregular basis with some of the other examples of depressions. An authentic simulation of economic depression does not have to include those noisy attributes. It is only essential that it adequately model the decline of GNP over time. Since an economic depression is already an abstraction in the minds of human beings an authentic simulation of economic depression is a simulation of an abstraction.

Simulations vary in authenticity as a function of the parallelism between the simulation and the phenomena it models,

$$A = f(p)$$

where A is the quality of authenticity, f indicates function and p is the degree of parallelism. Any real world phenomena can be experienced enactively, iconically and symbolically. Many conceptual phenomena (abstract ideas, relationships, systems, transformations) however, can only be experienced iconically and symbolically, and the iconic representation usually requires the use of heuristic devices such as graphs and diagrams. These devices themselves are tools which one must learn

prior to using them for creating iconic representations.[1]

Many relational concepts (i.e., economic depression, diminishing marginal returns, opportunity cost, balance of trade) can be taught by computer simulation with a high degree of authenticity because the relationships can be represented by the computer iconically and symbolically. In these computer simulations the parallelism can be partitioned between the iconic experiences factor and the symbolic experience factor. Thus the expanded form of the formula becomes:

$$A = f(p_i + p_s)$$

where A is the authenticity of the instructional computer simulation, p_i is the parallelism of the iconic experience factor and p_s is the parallelism of the symbolic eperience factor. If only one of the factors is adequately paralleled in the simulation then the simulation is severely deficient in authenticity.

Social phenomena have the additional feature of being available as enactive representations of experience, even though the phenomena may be considered an abstract relationship or a system. Just as in social phenomena part of a complete experience of the phenomena incorporates enactive, iconic and symbolic experience so the authenticity of a social simulation depends upon the extent to which the parallelism incorporates enactive, iconic and symbolic experience factors. In a social simulation the parallelism can be partitioned between the enactive experience factor, the iconic experience factor and the symbolic experience factor. Thus an expanded form of the formula becomes:

$$A_{si} = f(p_e + p_i + p_s)$$

[1]It might be argued that the act of drawing the graph or diagram which iconically represents the abstraction is an enactive experience. While this is true it is an enactive experience of the graph or diagram, not the abstraction. Similarly one might argue that the misery one experiences in an economic depression would necessarily be enactive. Although misery is enactive experience it does not follow that it is an enactive experience of an economic depression as defined here. Rather it is an enactive experience of poverty or unemployment or hopelessness.

where A_{si} is the quality of authenticity, f indicates function, p_e represents the parallelism of the enactive experience factor, p_i represents the parallelism of the iconic experience factor, and p_s represents the parallelism of the symbolic experience factor.

It should be remembered that the enactive, the iconic and the symbolic factors in a social simulation of an abstraction necessarily refer to the mental representations of the abstraction in these three varied modalities. Thus in a social simulation like Diplomacy the experience of deceiving another or being betrayed by another is enactive experience of the art of diplomacy; the experience of the spatial distributions on the map of Europe are iconic; and the experience of planning for a discussion of strategies with an ally is symbolic. By way of clarification, however, because the simulation of a social system necessarily implies the simulation of the relational conceptual components of the system, parallelism of the enactive factor does not necessarily require the demonstration of enactive parallelism of all the conceptual components of the system. Rather the enactive parallelism of a social system is defined in terms of the enactive experience of the social participation in the system.

From this perspective a computer simulation of a social system would rate high on authenticity only if the computer simulation incorporates experiences which parallel all these kinds of representational factors. As a computer cannot create a parallel to enactive social experience, adequate instructional computer simulations of social systems must involve the student in group processes outside the computer.

The implications for the design of instructional simulations for social studies are clear.

1. Instructional computer simulations, as differentiated from the general category of computer simulations, are adequate instructionally only to the extent that they make explicit the set of relationships underlying the program for the simulation.

2. Instructional simulations of abstract relationships must at a minimum provide both iconic and symbolic representations of the relationships.

3. Instructional simulations of social relationships and systems must not only provide iconic and symbolic representations of the systems, they must also provide, in a context external to the computer, for enactive experience to authenticate the parallel enactive social experience in the real world phenomena. Providing a computer simulation learning experience in which a student role plays a policy maker who manipulates variables in a social system in order to maximize some abstract good, without making that student acknowledge in some sense that he/she is by implication bankrupting others with impunity or committing others to starvation, can hardly be considered sound social education. Instructional simulations must carefully accomodate more than the intellectual understanding of social relationships and systems. They must also acknowledge the social responsibilities which are entailed in policy making.

The implications for high school social studies teachers are also clear.

1. High school social studies teachers must be able to differentiate between relationships and systems and between social and non-social abstract content. Whereas non-social relationships (i.e., economic depression, gerrymander, balance of trade, opportunity cost, comparative advantage, etc.) and non-social systems (i.e., communications networks, international monetary systems, parliamentary systems, electoral processes) can be taught with computer simulations which are self-contained, social relations and social systems necessarily require a social element as an add-on to the computer simulation component. Thus a sophisticated understanding of social studies content is a pre-requisite to the use of instructional computer simulations in the social studies.

2. When instructional computer simulations of non-social relationships and systems are used, teachers have an obligation to debrief students on the connections between these relationships and systems and associated social systems. If, for example, a computer simulation of the concept 'economic depression' is used, part of the debriefing must be directed to showing how a decline in GNP over time acts through the economic system to impact on the individuals of related social systems. The idea of a misery index as a means of assessing the social impact of economic policy would be one way of incorporating an enactive dimension into computer social simulations and developing implications of non-social system changes for social systems. Perhaps every instructional social simulation should have a sub-routine for calculating a misery index for each policy a learner tries out.

The new computer technology is, like any invention, value neutral. In the hands of a reflective and insightful teacher it can provide a bridge to a new depth of insight into the operations of modern society. On a more pessimistic note, in the hands of non-reflective or undereducated teachers it could aid the evolution of a new bureaucratic barbarism.

REFERENCES

Fraas, John, "The Effectiveness of a Simulation-Gaming Method of Instruction for Teaching College Level Introductory Economics"(unpublished doctoral dissertation, University of Akron, 1977).

Hunt, Maurice P. and Lawrence Metcalf, Teaching High School Social Studies, New York: Harper and Row, 1968.

Skinner, B.F., "The Shame of American Education", American Psychologist, 39, 947-954.